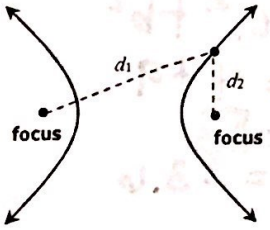
| Name: | Date: |
|---|---|
| Topic: | Class: |

| Main Ideas/Questions | Notes/Examples |
|---|---|

## HYPERBOLAS

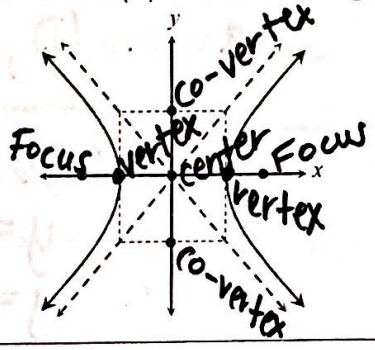
An hyperbola is a set of points such that the **difference** of the distances from any point on the hyperbola to two fixed points remains constant. These fixed points are called the **foci.**

$d_1 - d_2$ remains constant for all points on the hyperbola!

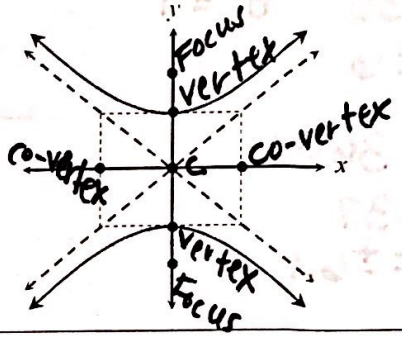



## TYPES OF HYPERBOLAS

**HORIZONTAL** (opens left and right)




**VERTICAL** (opens up and down)




- The **center** $(h, k)$ is the midpoint of the foci.
- The **asymptotes** are the diagonal lines that "guide" the curves.
- The **vertices** (turning points) are $\pm a$ units away from the center.
- The **co-vertices** are $\pm b$ units away from the center.
- The **foci** are $\pm c$ units away from the center.
- **Formula to find $c$:** $c^2 = a^2 + b^2$

## STANDARD FORM
Center at $(h, k)$

$$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$$

$$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$$

## *Equations of* ASYMPTOTES

$$y = \pm\frac{b}{a}(x-h) + k$$

$$y = \pm\frac{a}{b}(x-h) + k$$

## GRAPHING HYPERBOLAS

- ✓ Write the equation in **standard form.**
- ✓ Graph the **center**, $(h, k)$.
- ✓ Graph the **vertices.** Use the first denominator, $a$.
- ✓ Graph the **co-vertices.** Use the second denominator, $b$.
- ✓ Use the formula $c^2 = a^2 + b^2$ to find and graph the **foci.**
- ✓ Write equations for the **asymptotes** and graph them.

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**Directions:** Graph each hyperbola. Identify the center, vertices, co-verticies, foci, and asymptotes.

**1.** $\frac{x^2}{4} - \frac{y^2}{9} = 1$

$a^2 = 4 \quad b^2 = 9$

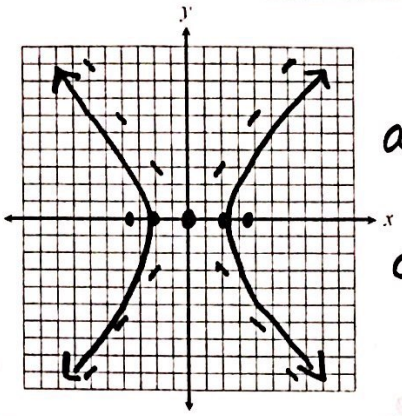
$a = \pm 2 \quad b = \pm 3$

$c^2 = a^2 + b^2$

$c^2 = 4 + 9$

$\sqrt{c^2} = \sqrt{13}$

$c = \pm 3.6$



Center: (0,0)

a Vertices: (2,0) (-2,0)

~~Co-Vertices:~~

c Foci: (3.6, 0) (-3.6, 0)

Asymptotes: $y = \pm \frac{3}{2}(x-0)+0$

$y = \pm \frac{3}{2}x$

**2.** $\frac{y^2}{36} - \frac{x^2}{1} = 1$

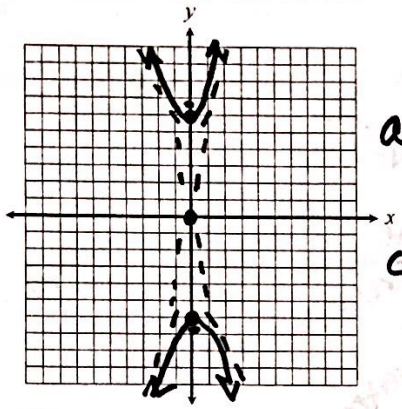
$a^2 = 36 \quad b^2 = 1$

$a = \pm 6 \quad b = 1$

$c^2 = 36 + 1$

$c^2 = 37$

$c = \pm 6.1$



Center: (0,0)

a Vertices: (0,6) (0,-6)

~~Co-Vertices:~~

c Foci: (0, 6.1) (0, -6.1)

Asymptotes: $y = \pm \frac{6}{1}(x-0)+0$

$y = 6x$ & $y = -6x$

**3.** $\frac{(x-3)^2}{25} - \frac{(y-2)^2}{16} = 1$

$a^2 = 25 \quad b^2 = 16$

$a = \pm 5 \quad b = \pm 4$

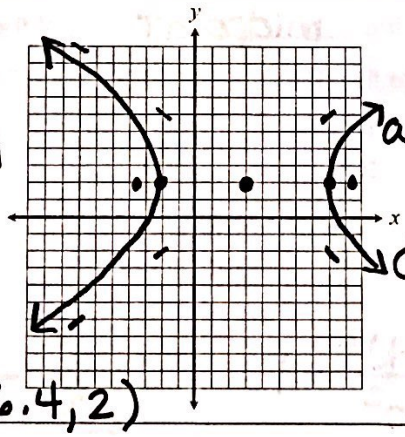
$(3 \pm 5, 2)$

$c^2 = 25 + 16$

$\sqrt{c^2} = \sqrt{41}$

$c = \pm 6.4$

$(3 \pm 6.4, 2)$



Center: (3,2)

a Vertices: (8,2) (-2,2)

~~Co-Vertices:~~

c Foci: (9.4, 2) (-3.4, 2)

Asymptotes: $y = \pm \frac{4}{5}(x-3)+2$

$y = \frac{4}{5}x + 4.4$ & $y = -\frac{4}{5}x - 0.4$

**4.** $\frac{(y-3)^2}{36} - \frac{(x+1)^2}{9} = 1$

$a^2 = 36 \quad b^2 = 9$

$a = \pm 6 \quad b = \pm 3$

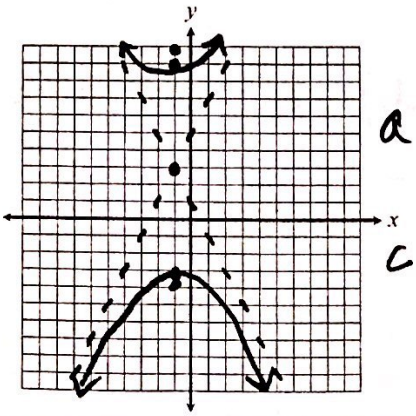
$(-1, 3 \pm 6)$

$c^2 = 36 + 9$

$c^2 = 45$

$c = \pm 6.7$

$(-1, 3 \pm 6.7)$



Center: (-1,3)

a Vertices: (-1,9) (-1,-3)

~~Co-Vertices:~~

c Foci: (-1, 9.7) (-1, -3.7)

Asymptotes: $y = \pm \frac{6}{3}(x+1)+3$

$y = 2x + 5$ & $y = -2x + 1$

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